

Lewis Structures - Summary

A. Drawing Lewis Structures

1. Calculate the total number of valence electrons (consider charge in the case of ions).
2. Build a skeleton of the Lewis structure:
 - 2.1. Define a central atom.
 - 2.2. Place the remaining atoms around the central atom.
 - 2.3. Link the central atom to each surrounding atom.
3. Complete the octet of the surrounding atoms (except Hydrogen, which only needs only 2 valence electrons).
4. Place any leftover valence electrons on the central atom.
5. Identify (or tag) the number of valence electrons around the central atom.
 - 5.1. Look to use multiple bonds in order to have the central atom satisfy the octet rule.

B. Exceptions to the Octet Rule

- Some central atoms will not follow the octet rule:
 1. Expanded octet (more than 4 atoms bonded to central atom):
 - Central atoms found in Periods 3 and up have an empty d orbital (ex: PCl_5).
 2. Incomplete octet (less than 4 atoms bonded to central atom)
 - Central atoms can be Be, B, or Al (ex: BH_3).
 3. Odd number of non-bonding valence electrons
 - Such is the case for molecules such as NO.

C. Resonance Structures

- It is possible for some molecules to have more than one way of placing the electrons between the atoms.
- Such structures are known as resonance structures (i.e., structures that differ only in bond positioning and lone pairs)
- Double headed arrows are used to identify resonance structures.
- Example O_3 :
$$\begin{array}{c} \ddot{\text{O}}=\ddot{\text{O}}-\ddot{\text{O}}: \\ \vdots \quad \vdots \end{array} \longleftrightarrow \begin{array}{c} :\ddot{\text{O}}-\ddot{\text{O}}=\ddot{\text{O}} \\ \vdots \quad \vdots \end{array}$$

D. Co-ordinate Covalent Bond

- It is possible that the central atom may donate two valence electrons in a single covalent bond.
- Such a bond is known as a co-ordinate covalent bond:
 - To determine if such a bond exist, compare the number of valence electrons around an atom to its number of non-bonding valence electrons.
- For an example of a co-ordinate bond, see the single bond in the Lewis structure of O_3 above.
 - Note that since oxygen (O) is in group 16, it has 6 valence electrons.
 - The central O only has 5 valence electrons (less than the number of valence electrons of O)
 - The surrounding O linked by a single bond has 7 valence electrons (more than the number of valence electrons of O).
 - Therefore, the single bond must consist of two electrons contributed by the central O.